REPORT

of the

SIXTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE

June 15 - 16, 1949

North Carolina State College,
Raleigh, North Carolina

Reported by

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PROGRAM FOR THE
SIXTH SOUTHERN PASTURE AND FORAGE CROP
IMPROVEMENT CONFERENCE

North Carolina State College,
Raleigh, North Carolina

June 15 - 16, 1949

Wednesday, June 15, 1949 — Patterson Hall

T. J. Smith, Chairman

8:30 AM — Welcome, Director J. H. Hilton

8:45 - 10:00 — State Reports

10:00 - 12:30 — Symposium - Ladino-grass Mixtures

R. L. Lovvorn, Chairman

E. N. Fergus, Ky.
J. K. Leasure, Tenn.
Loyd V. Bell, N. C.
O. E. Sell, Ga.

12:30 PM — Lunch

2:00 - 6:00 — Field Trip

8:00 — The Forage Problem of the South and its Regional Solution, by Dr. M. A. McCall, USDA, BPISAE, Beltsville, Md.

Thursday, June 16, 1949

8:30 - 10:00 AM — Design of Pasture Experiments, by Dr. H. L. Lucas, Statistics Dept., North Carolina Agric. Expt. Station

10:00 - 12:30 — Symposium - Place of Alfalfa in the Southeast

T. J. Smith, Chairman

R. G. Henderson, Va.
J. L. Allison, USDA and N. C.
D. G. Sturkie, Ala.
L. C. Olson, Ga.
C. H. Hanson, USDA and N. C.
W. W. Woodhouse, N. C.

12:30 PM — Lunch

2:00 - 6:00 — Field Trip

Rooms for the members of the Conference have been reserved in the Alexander Dormitory (same as in 1941). Register in for the Conference at the dormitory.

The field trips, as listed for June 15 and 16, will cover the various phases of forage and pasture improvement investigations under way in and around the main station at Raleigh. In addition to these investigations there are a number of excellent forage and pasture programs under way at other experiment stations over the state. Members of the Forage Crops Department at North Carolina will be available to conduct groups to these stations on Friday. It is suggested that those interested in one of these side trips consult Roy Lovvorn or Bill Woodhouse for final arrangements. The following is a brief description of the trips available and investigations under way at the other stations (Friday, June 17):

Option 1: Tidewater Station, Plymouth, N. C.

Located 125 miles east of Raleigh between Williamsport and Columbia on U.S. 64. Work on the station includes small plot trials involving adaptation of grasses and legumes and fertility trials with Ladino, big-trefoil, orchard grass, redtop and the fescues. Grazing studies include one 24-acre experiment comparing white clover, Ladino clover and big-trefoil for beef cattle.

Option 2: Lower Coastal Plain Station, Willard, N. C.

Located 105 miles southeast of Raleigh two miles below Wallace on U.S. 117. Small plot studies involve lespedeza strains including nematode resistant selections. Grazing trials involve Ladino clover, white clover, big-trefoil, fescue, kudzu and temporary grazing crops for dairy cattle.

Option 3: Mountain Experiment Station Farm, Waynesville, N. C.

Located on U.S. 19 and 23, thirty miles southwest of Asheville on the eastern edge of the Great Smokies. Small plot studies involve adaptation of grasses and legumes and fertility trials with Ladino and alfalfa. Grazing trials of an observational nature with Ladino, birdsfoot trefoil, fescue and orchard grass for diary cattle.

Option 4: Grassland Farmers in vicinity of Raleigh

This will include several former row crop farms that are now entirely in grass and legumes.

SIXTH SOUTHERN PASTURE AND FORAGE CROP IMPROVEMENT CONFERENCE
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Wednesday, June 15, 1949 — Patterson Hall
8:30 A.M.

Opening Session — T. J. Smith, Chairman

Director J. H. Hilton, of the North Carolina Agricultural Experiment Station, was introduced by Dr. Smith. Dr. Hilton welcomed the group back to North Carolina. He stated that the changing agricultural picture in the South is due largely to the development of the livestock industry. Agriculture in the South, according to Dr. Hilton, has been long on cash crops, lacking in diversification and rotations, with too little attention being paid to soil improvement and to the control of soil erosion. However, the livestock enterprise in the South is dependent upon the development of productive pastures and forage crops - your job in the over-all picture. Dr. Hilton pointed out that the livestock industry had been stimulated by the research knowledge that much of our sub-marginal land can be profitably used for livestock production. We fully expect the excellent forage and livestock research programs, closely coordinated with an alert educational program, to play a most important part in the improvement of southern agriculture.

8:45 A.M. — State Reports of Forage Research Activities.

Texas - R. C. Potts

Texas has some 32 experimental units throughout the state doing agricultural research. Two-thirds of these experiment stations are doing some research on forage production. The research of the Texas Agricultural Experiment Station on production of forage is divided into two divisions: Agronomy, and Range and Forestry. The control of brush, management of the range and reseeding are some of the major problems with which the Department of Range and Forestry are concerned.

The Agronomy Department has underway extensive research in an effort to find the best rates and ratios of fertilizers to use with the various forage crops. Species and strains of grasses and legumes are being tested under the various conditions in the state in an effort to determine those species best adapted for the production of forage under various climatic conditions. Tests are under way at the various substations to determine the most productive annual and biennial species that may be used not only for forage production but also for soil improvement. An effort is being made to find superior species for seeding in stubble following a rice crop and one that will fit well into a rice-pasture rotation. Through a breeding program an attempt is being made to develop strains of both native and introduced species of grasses and legumes that are more drought and disease resistant, remain green longer and produce a greater quantity of seed. There are many problems yet to be solved in relation to forage production but we feel that we have gotten a very good start in this line of work.

Oklahoma - W. C. Elder

Pastures were very good in Oklahoma this past year. The state depends to a large extent on native grasses for grazing and for hay. These grasses made a great comeback in 1948. Two or three million pounds of native grass seed were harvested. This seed was planted back in old abandoned cultivated land in the western part of the state in 1949. These plantings require special seeding machinery and seedbed preparation but no fertilizer is necessary.

Where pastures are being planted in eastern Oklahoma, Bermuda grass is the best grass. Annual winter legumes and Korean lespedeza are planted in Bermuda making a permanent pasture with a long grazing period each year.

Oklahoma is interested in a large number of pasture legumes and grasses. Mr. D. A. Savage and Dr. J. H. Harlan, Jr., of the Southern Great Plains Field Station, Woodward, Oklahoma, are carrying on intensive investigations with several native grasses, especially those found in the western section of the state.

Several tall native grasses found principally in the eastern part of the state along with Bermuda grass are being studied. Adapted strains of brome grass look promising for the better soils of the northern and eastern parts of the state.

Since a large part of the alfalfa seed is sold in the northern and eastern markets, the state must produce wilt resistant and winter-hardy stocks. White dutch and ladino clovers will grow only on a small area in the state but lespedeza and hop clovers are fitting into the pasture mixtures over a wide area. Sweet clover and hairy vetch are two prominent forage legumes in the state.

Louisiana - C. R. Owen.

The objectives in the breeding program at the Louisiana Experiment Station is the development of better adapted strains of Dallis grass, White clover, annual lespedeza and red clover. A program is also underway for the evaluation of new species, varieties and strains developed or introduced by institutions and agencies in other states. Testing for the evaluation is being done with small plots adequately replicated from which forage and seed production is used as the criteria. The harvesting is accomplished with clipping by the use of appropriate mowing machinery. It is planned that the information from this phase of the program be integrated into more comprehensive investigation of pasture establishment and animal production.

From the breeding work with Dallis grass two strains have been isolated which are being increased for seed production. It is thought that seed of these may be available in commercial quantities by 1952. Dallis grass is generally recognized as being the foundation species around which improved pastures are to be established in most sections of the state. The chief handicap to its use in the past has been the difficulty of establishing stands the first season. This factor may be largely overcome by judicious seeding rates based upon purity and germination of seed and by proper seedbed preparation. The

new strains, La 430 and La B230, have been more consistent in the production of better quality seed than domestic grass. They have also been superior for forage production.

White clover strains which are more persistent in growth habits and continue to live throughout the summer months are objectives for the improvement within this species. Clonal lines are on hand which have continued to live since April 1946. An effort is being made to form synthetic varieties utilizing lines all of which have exhibited the perennial tendency. Tests are being conducted to determine the extent of cross-compatibility present between each line. Single crosses of all combinations of a group of lines are being attempted by the use of nuclei colonies of bees under screen cages. Synthetic varieties are also being formed from the better lines of red clover. Mildew resistance is one of the improvements sought.

Certain new strains and species of grasses and legumes have appeared to offer promise as additions to the list of pasture crops. Among the grasses are the tall fescues, certain strains of brome grass and Harding grass. Big trefoil (Lotus uliginosus) appears well suited for growth during the excessive rainy seasons. Tall fescue grows well in mixtures with white clover. The different strains of white clover have appeared excessive in the range of variation. It is evident that recommendations for adapted varieties should be much more specific than has been considered previously.

Tennessee - J. K. Leasure.

Pasture and forage investigations in progress are concerned with the following phases: pasture fertilization, mixture studies involving mixture evaluation, seeding rates and effects; alfalfa seed production, grass and legume breeding, uniform variety testing of alfalfa and red clover and evaluation of pastures in grazing tests with dairy cattle.

Investigations are being expanded to include grazing tests of more productive mixtures. Additional pasture plot technique studies are planned involving plot size and effect of preferential grazing on stands. Demonstrations are planned of the better fertilization practices as an essential phase of pasture programs in the state.

Alabama - T. H. Rogers.

Alabama is getting excellent results with reseeding crimson clover. The clover is being used in combination with common Bermuda grass, coastal Bermuda grass, Johnson grass, tall fescue, and sericea lespedeza. It is also being grown in rotation with grain sorghum. Approximately 3,000,000 pounds of crimson clover seed has been harvested in the state.

Considerable interest is being shown in the Farm Units established in various parts of the state by the Experiment Station. The oldest unit has been in force for twelve years. There are approximately fifteen units in the state. The primary purpose of the units is to apply research data to the entire farm program.

Georgia - O. E. Sell.

Grazing Experiments. (1) Improvement of native permanent pastures increased beef cattle gains 357 pounds per acre -- from 183 pounds on native pasture to 540 pounds per acre on improved pasture. Net annual cost of improvement -- seeds, lime and fertilizers -- have been $4.18 per acre. With beef valued at 20 cents per pound, the gross increased beef production in 1948 was valued at $71.40 and the net at $66.22 per acre.

(2) Yearling beeves gained 2.76 pounds daily on temporary oats -- crimson clover - rye grass winter pasture and 2.50 pounds daily on fescue-white clover. Per acre gains were 303 and 172 pounds respectively for the temporary and the fescue pastures, up to May 11. Additional gains during summer will be obtained. Other types of winter pastures are being established.

(3) Fertilized versus unfertilized temporary winterpastures produced 368 versus 209 gallons of milk per acre with gross value of $192.00 versus $110.00, and net values above feed and pasture costs of $100.00 versus $33.00 per acre respectively. Fertilization over a three-year period averaged 383 pounds 6-8-6 fertilizer applied at seeding time and 280 pounds nitrate of soda topdressed, at a total cost of $14.20.

These figures on livestock incomes from pastures may be particularly significant in the near future as showing possibilities for farm incomes which are likely to be reduced due to lower crop prices and acreage allotments.

Small Plot Experiments. (1) Periodic clipping of winter pasture, under adequate but varying nitrogem treatment, showed that low temperatures and possibly other factors greatly slow down or stop growth of pasture plants during mid-winter. Grazing data also indicate a much lower carrying capacity of pastures in mid-winter. This suggests fall forage growth should be accumulated for mid-winter grazing, and, or, that some reserve feed such as hay should be available.

(2) Best utilization of winter forage. Chemical analyses of fall and winter forage has shown that, if properly fertilized and managed, it contains generally from 18 to 30 percent protein, sometimes as high as 40 percent. Proper utilization to get greatest returns from winter pastures is essential. Consideration should be given first to use of pastures by milking cows, second by growing animals, and last by cattle being maintained. Experiments are planned to determine how winter pastures can be best utilized.

(3) Sod studies. Farmers frequently have abundant winter pastures but cannot utilize them due to wet soil conditions and danger of injuring the soil and pasturage. By use of a soil penetrometer and actual measurements of cow hoof depressions it was found that: fescue grass produces the best sod, with crimson clover on grass sod second best. The sod of temporary pasture was improved by: seeding ryegrass in mixture, cross-drilling or broadcasting rather than single drilling small grain and by compacting the seedbed.

(4) Plant breeding and selection. Over 1,000 white and Ladino clover plants introduced from old established pastures(mostly in Georgia), other states, and from foreign countries, comprise the germ plasm of the breeding program to

develop strains having a distinct perennial habit, high forage and adequate seed production. The seriousness of various plant diseases will be studied on a number of these types.

About 2,000 tall fescue plants, of diverse types, are under observation. Major diseases to which resistance must be found are Helminthosporium dictyoides, Rhizoctonia, and Anthracnose.

Over 70 smooth brome selections are under observation to determine the potentialities of this species for Georgia conditions.

Georgia Mountain Experiment Station. Orien Brooks has numerous grass and legume species and mixtures under test and is conducting fertilizer and lime experiments. A striking example of the value of a legume in grass mixture was shown -- fescue or orchard grass alone yielded about 2,000 pounds of dry forage per acre while with Ladino clover they yielded 8,000 pounds.

College of Agriculture at Athens. Dr. Edwin James is conducting experiments with alfalfa and studying the effect of time and method of harvesting crimson clover. He also has some bluegrass selections and is doing research on the factors affecting the hard seed content of strains of crimson clover.

Coastal Plains Experiment Station. Dr. Glenn W. Burton has a new leafy, shorter and later maturing strain of cattail millet. Seed can be combined from it. Progress has been made in the Dallis and sudan grass breeding programs but objectives have not been attained.

Work with the fertilization of Coastal Bermuda grass for use as a winter maintenance feed for cattle has created much interest. Ten tons of dry hay per acre were produced with a total application of 400 pounds of nitrogen per acre. The hay cost $8.50 per ton. The protein content of the hay was doubled by this fertilizer treatment and varied mostly from 17 to 10 percent in protein content. In a feeding test, heifers maintained their weight well on late cut Coastal Bermuda.

The results of sixteen years of winter grazing experiments have been summarized and will soon be published.

J. L. Stephens. Thirty acres of Coastal Bermuda grass have been set out for grazing tests. A pasture irrigation study has also been initiated in which plots of Bermuda, Dallis, and Bahia grasses are crossed with eight to ten clover species. Land is terraced at twenty-foot intervals and the terrace intervals flooded when needed.

Kentucky - E. N. Fergus.

Forage crops work at the Kentucky Agricultural Experiment Station consists principally of variety testing, crop improvement, pasture production and management studies, and determinations of nutritive value of species and varieties used as pasture, hay, and silage. However, the work is not as extensive as it would appear because the scope of the work in each category is limited in order that it may be rather intensive.

Testing of species and varieties to determine their adaptation and the factors affecting adaptation are basic studies. Variety improvement work in particular, is based upon results of these studies. If these studies show that some varieties are well adapted, those varieties are recommended for farm use. If no good varieties are found, the effort is made to develop them by selection and breeding.

Of the forage legumes, only red clover is in our improvement program. The new variety, Kenland, developed in cooperation with the BPISAE, is a product of this work. Of the grasses, most of the improvement work is with tall fescue, but orchard grass and Kentucky bluegrass also are receiving considerable attention. This work is still in the initial -- and to some extent exploratory stage - despite the several years of work that has been under way.

Studies of seed yields and production are restricted to Kenland red clover, Kentucky bluegrass, Ky. 31 fescue, and orchard grass. Studies of Kenland seed yields attempt to determine practices that will produce largest amounts of seed per unit of seed sown, the largest yields per acre and the best quality of seed. In the grasses, these studies are to determine how to obtain high yield and quality of seeds as sods become older. One result of the study of Kentucky bluegrass shows that control of two destructive insects in the field is essential to high "clean out" of seed and that control can be effected with certain insecticides.

Pasture studies, though broad in statement are limited in scope. They are of 3 kinds: (1) Fertilization practices: kinds, amounts and placement; (2) herbage and grazing produced by species and mixtures; (3) nutritive value of species and varieties.

Silage studies are limited to the determination of relative feeding values of silage made of a few forage species.

North Carolina - R. L. Lovvorn.

Management: Results from the pasture evaluation technique study initiated last year indicate that (1) Ladino recovers more rapidly following drought than does white clover, (2) tall fescue subjects Ladino to more severe competition than does orchard grass, and (3) a fair degree of precision can be obtained in grazing trials in this area without resorting to excessively large or expensive layouts.

Ladino clover acreage is still rapidly expanding in North Carolina. New projects with Ladino include an evaluation of it and big trefoil with beef cattle. Big trefoil appears quite promising in the Tidewater area.

Ecological studies of grasses with alfalfa emphasize competition for both moisture and nutrients. Root distribution investigations show a maximum penetration of alfalfa roots of about 6 feet, which is usually attained by the end of the first year. Expansion of alfalfa management studies is contemplated with increased emphasis on diseases.

Soil Fertility: Ladino clover and alfalfa have very similar fertility requirements. Big trefoil seems to be equally exacting as to phosphate supply but less sensitive to lime and potash levels.

Both alfalfa and Ladino fluctuate widely in their potash content from time to time during the season, making it difficult to define the critical K level under field conditions. Companion grasses also influence the potash fertilizer requirements of these legumes. Potash uptake by several grasses is being studied. As compared with alfalfa, Ladino is less responsive to, but seems to be equally tolerant to boron applications.

The efficiency of topdressed phosphate on alfalfa and Ladino is being studied, using P_{32}. Studies on soil P build-up with less soluble sources are planned.

Placement studies with lime and fertilizers show alfalfa to be quite sensitive to placement of limestone. Placement treatments on alfalfa have long lasting effects.

Breeding: In the alfalfa breeding project intiiated three years ago, emphasis has been placed on the collection and evaluation of available plant materials. Yield, disease, and other data have been obtained on more than 200 varieties and experimental lots. The older stands of Atlantic, DuPuits, and the more productive wilt-resistant lines from the Midwest offer a promising source of breeding material. On the basis of polycross and progeny performances, outstanding individuals will be combined and tested as synthetics. Much credit is due the Kansas and Nebraska Stations for their cooperation and support of this program.

Sclerotinia stem rot caused considerable damage to seedling alfalfa in North Carolina during the past winter. Severe damage, however, was confined largely to those fields where the alfalfa followed one of the clovers. DuPuits, an introduction from France, appears to possess a moderate degree of resistance to the causative organism.

Several selections of annual lespedeza have been more productive than the commercial checks. Last year crosses were made between divergent types to study the inheritance of several characters and to obtain estimates of genetic variability. Differences noted among lines in respect to resistance to the root knot nematode are consistent with previous observations.

Approximately seventy foreign and domestic strains of Lotus uliginosus and L. corniculatus have been studied in observational plots. A leaf and stem disease caused by Rhizoctonia appears to have been the predominate cause of stand losses. The open-pollinated progenies of the outstanding individuals among the surviving plants of L. uliginosus are being observed for seed and forage productivity and resistance to Rhizoctonia.

South Carolina - E. H. Stewart and W. R. Paden.

The farmers of South Carolina are showing much interest in tall fescue-Ladino clover combinations for permanent winter grazing purposes. The success has been very favorable generally. Some disappointments have occurred where

attempts were made to grow the crop on soils having low fertility levels. When recommended practices for establishing this mixture are followed, little difficulty has been encountered. However, observations of established stands indicate more information is needed on management in order to maintain a desirable mixture. Results of some seedings indicate the need of good sources of certified seed. In many cases excess growth has been obtained and the crop has been harvested.

Crimson clover and ryegrass have also taken an important place in this state as winter grazing crops. Preliminary tests on three strains, or selections of reseeding Crimson clover, which includes Dixie, Auburn and Autauga, indicate there is very little difference in the dates of their maturity. All strains were considerably infested this year with the Sooty Blotch disease. Reseeded stands of Crimson clover in some areas were infested with Sclerotinia rot. Here again it would be desirable to obtain strains more resistant to common diseases and have an earlier maturing clover that would better fit into a larger number of crop rotations. No selection or breeding work of this type is under way at the present.

Acreage of South Carolina crops for 1948:

Crop	Harvested Acreage, in Thousands	
	1937-46	1948
Corn	1613	1418
Cotton	1182	1130
Wheat	214	246
Oats	604	528
Hay, grain	19	13
Hay, cowpeas	362	120
Hay, soybean	28	30
Hay, peanut	26	25
Hay, lespedeza	125	266
Hay, other	25	46
Hay, all	587	500

The rather large acreage of wheat and oats grown for grain represents a high potential grazing source for an increase in livestock production for the state. Continued selection work for disease resistant and forage strains is highly desirable. The large acreage of lespedeza grown for hay warrants breeding and selection work for better yielding and more disease-resistant strains. Strain testing of annual lespedeza is being carried on in cooperation with the Forage Crops Division of the Bureau of Plant Industry.

Alfalfa is rapidly becoming a popular forage crop of the farmers of this state. Many are finding that it can be grown successfully. Fertility studies being carried on by research workers indicate that it responds readily to high fertilizer applications when grown on Cecil sandy or clay loam soils. An application of 2 tons of lime gave an increase of nearly a ton of hay over one ton for the 2-year period at a cost of only $5.00 more for the extra lime. An additional 1000 lbs/acre of superphosphate drilled in the surface increased the hay yield over 3/4 of a ton over that produced by 1000 lbs/acre of complete fertilizer having a 4-10-6 analysis. Addition of another 1000 lbs. of superphosphate over and above that listed above increased the yield another 3/4 ton.

Definite boron deficiencies are showing up on this soil type as well. Tests on Ruston and Orangeburg sandy loam soils of the Coastal Plain indicate that alfalfa can be grown successfully on them. From 3 to 5 tons of hay per acre were obtained from well fertilized plots during the first growing season.

Florida - G. B. Killinger.

Investigations are being continued with Pangola grass, coastal Bermuda grass and Pensacola Bahia grass in combination with winter and summer legumes. This search is for a higher beef producing pasture mixture than carpet-white clover pastures.

Argentine Bahia grass, a recent introduction, continues to look good in trial field plots and pasture plantings.

Kenland and midland strains of red clover look very promising at several locations in Florida. Some mildew is in evidence at seeding time. Both clovers have produced an excellent crop of seed this season.

A new large scale pasture grazing experiment is being initiated near Gainesville on a tract of cut-over pine land, chiefly made up of Leon soils. Eighty-acre pastures and separate cow herds will be used for the production records along with herbage yields and chemical composition. The Range Cattle Station, at Ona, already has a cowherd experiment under way with somewhat smaller pastures.

Considerable enthusiasm has been had the past year for Rhodes grass and Panicum repens (Torpedo grass) by Florida cattlemen.

Besides the outlying stations previously reporting pasture investigations in Florida, a new station known as the West Florida Experiment Station near Milton, is now doing some pasture research. Investigations with Lotus, Indigo, Melilotus and sweet lupines are being continued. Hay production and mechanical curing is receiving considerable attention with detailed experiments under way in this field.

Puerto Rico - P. Gonzales Rios.

Since Puerto Rico is thickly populated, much, if not all, of the better land is utilized in the production of foods for human consumption. Only marginal and sub-marginal lands are available for pasture and forage production unless extremely productive forage species are secured. At the present time Tropical kudzu, Pueraria phaseoloides,; Para grass, Pennisetum purpureum; and Guinea grass, Panicum maximum, appear quite promising. Stocks of introduced and native strains of these species are providing a broad phase for selection and breeding work. A broad range of types from low-growing, somewhat decumbent types to very aggressive, tall-growing ones, have been selected from each of the grass species. Mixtures of these grasses with kudzu are looking promising.

10:00 A.M. SYMPOSIUM - LADINO-GRASS MIXTURES

R. L. Lovvorn, Chairman

Dr. Lovvorn gave a few introductory remarks indicating the necessity for more information on Ladino-grass mixtures in the southern United States. He pointed out that Ladino is adapted to a greater part of the southern region and is superior to many of the legumes we have used for pasture in the past. The problem at hand, according to him, would seem to be:

(1) What grass shall be planted with Ladino - orchard, tall fescue, or some other?

(2) What are the fertility requirements of Ladino grown with and without a grass?

(3) How shall the sward be managed?

a. To maintain the stand for a profitable length of time with a desirable proportion of grass and legume?

b. To realize the greatest animal yield (milk or meat)?

J. K. Leasure presented data showing that on replicated plots at Knoxville, Tennessee, where orchard grass and Ky. 31 fescue were each seeded with Ladino clover, redtop, and Kentucky bluegrass at different rates of seeding;

(1) Heavier rates of seeding resulted in thicker stands, but not proportional to the amount of seed, and with less pronounced differences the second year than the first.

(2) Thin-seeded stands the second year had thicker stands than thick-seeded stands the first year.

(3) Thick-seeded stands shifted very noticeably to wide grass-legume ratios.

(4) No noticeable difference in performance of orchard grass and Ky. 31 fescue.

Upon questioning, Mr. Leasure indicated that:

(1) He would not include redtop and Ky. bluegrass in similar experiments in the future.

(2) No chemical analyses were made.

(3) Higher P_2O_5 application possibly would have maintained a larger amount of clover.

Loyd V. Bell, graduate student, North Carolina State College, gave the following report:

This report is based on results from a pasture management experiment conducted at Raleigh, North Carolina. In this experiment there are eighteen one-acre paddocks. There are two replications of two seeding mixtures, each of which is being tested under four grazing managements. The seeding mixtures are Ladino clover with tall fescue, and Ladino clover with orchard grass. The managements are continuous grazing, rotational grazing, heavy rotational grazing, and delayed grazing. In addition, there are two replications of paddocks seeded to orchard grass, white clover, redtop, and lespedeza. These two paddocks are being studied under only one grazing management, continuously grazed.

Harvests were made from randomized 4' x 4' cages in each paddock. A 3' x 4' swath was clipped with a power mower from each caged area and from an area not caged four feet removed from the caged area.

Grazing during the summer of 1948 was done at an intensity considered to be optimum.

There were essentially no differences between managements or seeding mixtures as measured by total yields from the clippings under the cages. However, there were differences in the distribution of the amount of forage available during the grazing period.

Yield in Pounds Per Acre of Dry Matter

Clipping Date	Fescue-Ladino	Orchard-Ladino	Mixture
June 1, 1948	1507	1763	1907
June 15, 1948	1069	1217	1181
June 29, 1948	350	296	319
Aug. 10, 1948	444	595	118
Aug. 24, 1948	1068	1164	479
Sept. 7, 1948	743	815	457
Sept. 21, 1948	643	349	573
Oct. 6, 1948	511	246	63
Dec. 7, 1948	739	435	136

Due to the dry weather, seven weeks of grazing were lost on the Louisiana white clover-lespedeza-grass paddocks; but only four weeks were lost on the Ladino-grass combinations.

Ladino flowered more readily in mixture with tall fescue than with orchard grass.

Botanical separations gave the following results:

Percent Composition of Herbage

Date 1948	White Clover	Orchard Grass	Redtop	Lespedeza	Weeds
Aug. 10,'48	27.9	23.1	35.4	5.4	8.2
Dec. 7,'48	75.9	8.8	6.5	0	8.8
Apr. 12,'49	30.8	18.8	19.7	0	30.8

Percent Composition of Herbage

Date (1948)	Fescue	Ladino	Weeds	Orchard Grass	Ladino	Weeds
Aug. 10	53.3	39.7	7.0	51.7	32.8	10.1
Dec. 7	48.0	51.2	0.8	86.6	11.9	1.5
Apr. 12,'49	34.0	63.0	3.0	40.7	46.3	13.0

Chemical analyses of separations of small plots seeded to the same mixtures gave the following results:

	% N	% CaO	% P_2O_5	% K_2O
Orchard grass	2.6 to 2.7	0.7 to 0.8	1.6 to 1.7	4.5 to 5.6
Tall fescue	2.4 to 2.7	0.7 to 1.0	1.3 to 1.5	4.4 to 5.5
Ladino with orchard grass	3.3 to 3.4	2.2 to 2.4	0.8 to 0.9	3.1 to 4.8
Ladino with tall fescue	3.3 to 3.5	2.3 to 2.6	0.8 to 0.9	2.4 to 4.4

O. E. Sell discussed the behavior of Ladino-grass mixtures under Georgia conditions. He reports that disease is a primary factor to be considered under their conditions. Helminthosporium dictyoides is very prevalent during winter months on tall fescue, and Rhizoctonia also is prevalent. They have usually experienced difficulty in differentiating between loss due to disease and loss due to adverse soil conditions such as high temperature in white clover and Ladino seedings.

Dr. Sell thinks orchard grass is almost, but not quite, as well adapted as tall fescue in the mountain sections, whereas fescue is, in general, more widely adapted in the Piedmont. Orchard grass has not yet been found suited to the Coastal Plains.

Experiments with seeding rates of 5, 10, and 15 pounds of fescue per acre showed that it is advantageous to seed 10 or fewer pounds per acre.

Preliminary experiments of nitrogen on fescue have been hampered by disease on this grass. However, the results from Georgia look promising with regard to obtaining 12 months of grazing from fescue.

Tall fescue seems to have greater inherent potentialities than orchard grass and consequently more research emphasis is being placed on fescue in Georgia. An intensive program of introduction, selection, and breeding of tall fescue and white clover with emphasis on the disease aspect has been initiated.

Ladino has shown distinct superiority to white clover in the amount of forage produced. In the mountains of Georgia common white clover produced only 2,000 pounds, Louisiana white clover 4,000, while Ladino produced 6,000 pounds of dry matter per acre. However, under the conditions of South Georgia, Ladino and white clovers act primarily as annuals under present management systems.

12:30 P.M. Lunch.

2:00 P.M. - Field Trip W. W. Woodhouse, in charge.

In the afternoon, a short field trip was conducted by the North Carolina forage crops' staff.

The first stop was at the forage crop dryer which is located adjacent to the college campus on a North Carolina Department of Agriculture Experimental farm. This dryer was built in the spring of 1948 at an approximate cost of $5,000. It is heated by fuel oil and the circulation is aided by a 36-inch fan powered by a 5-h.p. electric motor. With such a system the temperature can be maintained at 118° F. An exhaust mechanism is attached, allowing the relative humidity to be controlled. The dryer is now in its second season of operation and the following conclusions have been reached:

1. It is possible to dry material quicker and cheaper on the slatted floor in the tunnel than in the larger rooms of the house.

2. Because of the fact mentioned in (1), it is suggested that future dryers be constructed slightly different from this one. It would probably be best to place emphasis on building several slatted floor bins and to have storage space nearby for the samples rapidly dried in the bins. This could probably be done with a smaller motor than is being used at present.

3. Approximately 50 gallons of fuel oil are required to dry a group of from 80-120 alfalfa samples each having a dry weight of approximately 1500 grams. (This data on the tunnel is irrespective of material being dried at the same time in the storage rooms)

At the same stop part of the forage crop equipment was on display.

Stop Number 2: (On same farm as Number I - one mile west of forage dryer)

Alfalfa Nurseries

The preliminary alfalfa trials are planted in two 16-foot rows, replicated 4 times. Rows are spaced one foot apart. Mimeographed data on the yield of 100 varieties and experimental lines were distributed. Some of the experimental lines present favorable sources of breeding material. The clonal nurseries inspected later in the afternoon also exhibited a considerable range of variability. The clonal nurseries were established in 1947 and 1948 and consisted of cuttings from plants selected for resistance to bacterial wilt and some of the leaf and stem diseases. Stand losses have occurred largely during late summer and early fall. Characteristic symptoms of diseased plants are dwarfing and yellowing. Fusaria were isolated from some of the diseased specimens by Dr. [illegible] Allison.

Stop Number 3: (Across highway from Stop Number 2)

Experimental Crop Dryer

Mr. John Weaver, of the Agricultural Engineering Department presented data

pertaining to the drying of baled alfalfa hay. Following a survey of crop production and drying in North Carolina, this dryer was constructed to meet the needs of the average farm for drying such crops as the forages, peanuts, seed and shelled corn, sweet potatoes, and the small grains.

Stop Number 4 was at Meredith field, on a Cecil clay, about three miles from Stop Number One. It is located on one of the college dairy farms. Two series of small plots were observed at this stop. The first series was a pasture management study involving a comparison of orchard and fescue with Ladino under heavy, delayed, and rotational clipping managements. The results of this experiment are to be correlated with the results obtained in a larger, 18-acre, grazing trial nearby. This large grazing trial is the same one which was discussed by Loyd Bell in the Ladino-grass symposium earlier in the day.

The next series of experiments was one involving rates of PKL and B on alfalfa and Ladino. This same experiment (without the Ladino) is replicated on a Norfolk sandy loam about twenty-five miles from Raleigh, and in the Tidewater area (big trefoil substituted for alfalfa) and in the mountains of western North Carolina. Information from all experiments will be summarized here.

The primary objectives of this study are:

1. To determine the response of alfalfa, Ladino clover, and big trefoil to rates of application of phosphate, potash, limestone and borax.

2. To establish the upper limit of response to these materials on the part of these legumes.

3. To compare the fertility requirements of alfalfa, Ladino clover and big trefoil.

4. To study the effect of these treatments upon the nutrient uptake of these plants.

5. To study the effect of these treatments upon the nutritive value of these plants.

Phosphorus treatments range from 0 to 400 pounds P_2O_5, potash from 0 to 400 pounds, limestone from 0 to 8 tons and borax from 0 to 40 pounds.

Detailed studies are being conducted on boron uptake, penetration and accumulation in two of these experiments.

Boron uptake seems to be influenced largely by borax and potash applications, being increased by the former and decreased by the latter. The critical level of boron in the soil for alfalfa seems to be just below 20 p.p.m. Boron was found to move downward very rapidly in the Norfolk and very slowly in the Cecil soil.

Alfalfa, Ladino, and trefoil all respond markedly to phosphorus application. The response to potash and lime is much less pronounced on trefoil than with the other two legumes.

A rather intensive inspection of the grazing experiment was anticipated. However, the review was cut short by rain. The results had been previously discussed in the morning session.

Stop Number 5 was about six miles west of Raleigh on the Animal Husbandry farm. Several large observational grazing trials were seen at this stop. The paddocks are seven acres in size but are not replicated. The same classes of animals are not maintained on the pastures, so results are not recorded as experimental data.

Stop Number 6: (Located on College Dairy Farm in a wet, low-lying area)

Lotus Nursery

Approximately 70 foreign and domestic sources of Lotus uliginosus and L. corniculatus have been studied. All of them appear to be quite susceptible to a leaf and stem disease caused by Rhizoctonia. Plants selected from among the surviving plants in the older plantings were permitted to produce seed under open-pollinated conditions. The open-pollinated progenies from most of the selected plants exhibited more vegetative growth, as well as greater seed production, than the commerical checks. Rhizoctonia had not yet become active in this nursery at the time of the field trip.

8:00 P.M. - Business Meeting - T. J. Smith, Chairman

The Nominating Committee, consisting of Messrs. Hein, Potts and Sell (Chairman), reported, resulting in the election of the following:

Executive Committee:

Hayden Rogers	Auburn, Ala.	4 years
Gordon Killinger	Gainesville, Fla.	3 "

Chairman for 1950 - C. R. Owen, Baton Rouge, La.

8:10 P.M. - The Forage Problem of The South and its Regional Solution, by Dr. M. A. McCall, Asst. Chief, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA, Beltsville, Md. (Summary of the talk by Dr. McCall)

Dr. McCall stated that, although the forage problems of the South are now pretty well known, he thought he should repeat them to emphasize them and to discuss their solution, particularly from the standpoint of developing the administrative machinery which would be necessary in solving them.

The South, Dr. McCall said, is potentially, and if properly developed, can be, the richest agricultural section of the country. With modern science there is no reason why its soils cannot be highly productive. Temperature and rainfall are not only favorable for crop production, but also add to the soil maintenance problem. Practically all the crops that improve the soil must be utilized as forage. Forage crops serve a three-fold purpose, (1) for livestock feed, (2) to provide nitrogen and organic matter, and (3) to hold our soils and to control erosion. You carry a load, he told the Conference, which you cannot shirk, and which you must meet if southern agriculture is to be what we feel it should and can be.

It is agreed, Dr. McCall continued, that we already possess the materials and knowledge which, if properly used, could largely solve the forage problem of the South. These, however, must be put in such form that they can be used by everybody who needs them. There is a gap between the development of principles and synthesizing them into systems that can be applied economically on farms. Ways should be found to encourage farmers to carry out what is really the final part of our job.

Referring to the report given during the Conference by T. H. Rogers, of work being done in Alabama with pilot farms, Dr. McCall said that pilot farms represent one of the most significant developments in the last twenty years and are the key to the beginning of a sound approach to implementing our research. Through these farms the farmer understands how he can take improved methods and apply them to his own problems. The farmer needs to have this understanding, and the information is needed to help him get necessary financial backing. The farmer does not now know how to use all information available to him to best advantage--in terms of what to plant, how to fertilize, how to maintain the soil as these relate to the economic management of his farm. The information he needs is not now synthesized into a series of farm operations and over-all management. We have to think of a forage research program in more definite terms, so that it takes into consideration all factors, such as soil, kinds of crops, companion crops, marketing, and financing. All of these must receive consideration because of the important role forage crops occupy in the program as a whole.

The southern part of the United States occupies a position midway between conditions of the tropics and the northern part of the Temperate Zone. Some useful material and findings will come from the tropics and some from the North. To utilize such diverse materials and principles more attention must be given to functional relationships, interpreted, of course, in terms of management.

Dr. McCall then turned to a review of the general philosophy of solving problems on a regional basis. When authorized in the 60's, the USDA and Land-Grant systems were given pretty much the same charters. Both could do about the same things under the law. The job was so big and resources were so limited that too little could be done in any line of work and overlapping was unimportant. The USDA did about the same things the States were authorized to do.

There is now a difference in several respects. There are more personnel, more funds are available, better training is provided, and we have a better understanding of problems of the several areas. The situation, from the standpoint of public interest, has also changed. We now have to think in more specific terms of what is the job of the USDA and what is the job of the State Experiment Stations.

Dr. McCall then raised the question of how to integrate what we are doing. Certain areas of work can be more adequately handled from the national level than from the state level, certain functions which the Department of Agriculture is able to render which will be of service to states in doing a better job. There are also certain functions in which the states can do a better job than the Department. There are other things which both, working together, can do better. We need to resurvey our whole philosophy and decide what each can do--what part of the job can be handled best by the Department to the advantage of the States--what part of the job the States should carry. We need to work out a plan for the Department to follow in working with the States. Dr. McCall assured the group that Department people would like to have the opportunity of sitting down with the States to work out ways in which they could both do a better job, and asked that they be invited to regional meetings where they could make suggestions in this regard.

Dr. McCall said he believed we should think of funds as a public trust and we should see that funds are spent so as to meet that obligation. Failure to do this will probably make it more difficult to get funds in the future.

Dr. McCall pointed out that procedures being established and machinery being set up under the Research and Marketing Act will make it possible to work out relationships and areas of responsibility better, since the authorizations to States and the Department, while essentially the same, are made more definite. The Research and Marketing Act, he explained, contains a provision to the effect that regional research projects must be coordinated. The Department believes that this coordination can be accomplished best by reaching agreement with the States. Dr. McCall said they do not feel that they have any special prerogatives or rights because they are a Federal agency. Their job is to encourage coordination and cooperation on a sound, helpful basis. Do not get the idea, he said, that we believe we have a right to tell the State Experiment Stations what they should do.

He suggested that in the future development of RMA projects, ways be found to discuss the problems involved with administrative people, in addition to the technical prople. He stated that, where research is authorized and there

are people in administrative work concerned with problems which the Government is trying to cope with by the use of appropriated funds, it is to the advantage of all to work on these things together.

In conclusion, Dr. McCall stated that all who realize their obligations in the broader aspect of research will recognize the fact that all problems having regional aspects can be solved better by using all available facilities. If this is done in the South, the forage work will go forward by leaps and bounds.

Thursday, June 16, 1949

8:30 - 10:00 A.M. T. J. Smith, Chairman

Design of Pasture Experiments, by Dr. H. L. Lucas, of the Institute of Statistics, University of North Carolina, Raleigh, N. C.
(Abstract of the talk by Dr. Lucas)

The discussion to be presented is limited to the types of experiments in which it is desired to estimate yield per acre in terms of animal product, and this estimation is done by the actual grazing of animals. There is a serious question as to whether or not such experiments are usually set up so that the most is learned for the money spent. The main factors to be considered, which in turn are dictated primarily by the purpose of the experiment, may be listed as follows: (1) what specific treatments are required to do the job, (2) what precision or sensitivity is necessary, (3) what are the costs involved in conducting the experiment, and (4) what are the economic consequences to the farmer of making a wrong recommendation?

The investigator will usually select his treatments such that they fairly effectively suit the purposes of the experiment. Although the economic consequences of making a wrong decision should be a governing factor in the funds allotted to a given project, it usually happens that there is a rather definite upper limit to the funds and facilities which an investigator has available for a given project. Thus, currently, the major problem in designing pasture experiments is arriving at a sort of balancing between items 2 and 3 listed above. In order to solve this problem it is necessary to consider various methods of increasing precision and the relative costs of the various methods.

Precision or sensitivity is fundamentally dependent on: (1) the sizes of the basic errors involved, (2) the number of replications, and (3) the degrees of freedom with which experimental error is estimated. The theory involved may be simply illustrated. Let

σ^2_p = between-pasture variance (Factors contributing to this are soil variability, variations in environmental effects on both forage and animals, and variations from pasture to pasture with respect to other factors such as planting procedures and dates, stand of forage, management of animals, etc.)

σ^2_a = between-animal variance (This is fundamentally determined by the sort of animals used.)

Then, the variance of a treatment mean, $\sigma^2_{\bar{y}_t}$, is given by

$$\sigma^2_{\bar{y}_t} = \frac{\sigma^2_p}{m} + \frac{\sigma^2_a}{mn} \qquad \text{(equation 1)}$$

where

m = number of pastures per treatment.
n = number of animals per pasture

Usually the acreage of land to be used for a study is predetermined, thus rendering mn essentially fixed. Hence, the contribution of animal variability to the variance of a treatment mean cannot be changed. On the other hand, increasing the number of pastures per treatment m, by making them smaller, results in a decreased treatment variance. In general, therefore, pasture experiments of the type being discussed can be improved by using several small plots per treatment, rather than one large plot as has been commonly done.

The precision of an experiment increases as the degrees of freedom for error increase. The number of degrees of freedom for error increases with m and is not affected by n. Therefore, increasing the number of pastures at the expense of pasture size has a two-fold beneficial effect on precision. It should be noted that, when one plot per treatment is used, the degrees of freedom for error are zero and error cannot be estimated. This is obviously unsatisfactory experimentation.

A practical question arises as to how far one should go in reducing pasture size. For a given total area of land, cost increases as pasture size is reduced, because increased fencing and watering facilities are needed, and a little more labor is required to handle the animals. When fencing and watering costs are prorated over a period of years, however, they are not so large as they might seem at first thought, and are small relative to the increased information which one obtains. Additional factors to consider are how σ_p^2 and σ_a^2 may change as pasture size is varied. With regard to σ_a^2, this component of error is practically independent of pasture size, unless, perhaps, the pastures get so small that they will carry only one animal. In this event σ_a^2 may increase slightly. With regard to σ_p^2, it is known that the portion of this due to soil increases somewhat as pasture size is diminished. The increase in σ_p^2 is more than overcome, however, by the accompanying increase in m, so that a net gain in precision always results. In experiments where constant utilization is maintained by periodically adjusting the number of animals as the forage growth dictates, it is, of course, more difficult to regulate grazing rate closely when the number of animals per plot is small. If adjustments are made at fairly frequent intervals, however, the increase in σ_p^2 due to this factor will be very slight over a season.

Certain results from small pasture grazing experiments at North Carolina State College corroborate the idea that decreasing the size and increasing the number of pastures increases precision to a considerably greater extent than the increased cost involved. Sufficient data have not been accumulated as yet, however, to decide on the most efficient pasture size. It appears certain, however, that experiments should be designed such that there are at least two plots per treatment and at least 8 to 10 degrees of freedom for error.

If yielding ability varies greatly from one treatment to another, there is some theoretical advantage to varying the size of, but not the number of, pastures from treatment to treatment. One might render plot size inversely proportional to the yields expected. Thus, the number of animals per plot could be kept fairly uniform from one treatment to another. This procedure seems also to have certain practical advantages.

Breeding Alfalfas For The Southeast

Clarence Hanson*

Those who have studied the history of alfalfa introductions inform us that seed from Europe was brought into the Eastern States several times during the eighteenth century. However, its establishment as a crop probably did not take place until the time of the gold rush of 1849, when seed from Chile was introduced into California. It spread rapidly eastward to the Mississippi Valley and northward. From this reservoir of germplasm has evolved an array of distinct varieties from California and Arizona Common in the South to Dakota Common in the North. The Common alfalfas, together with other varieties of natural origin such as Grimm, Ladak, and Baltic, make up a conspicuous part of the alfalfa acreage in the United States.

The discovery of the bacterial wilt organism as a destructive agent in the western fields stimulated the development of breeding programs and the search for resistance. Buffalo alfalfa was developed from resistant plants found in an old field of Kansas Common. Introductions from Turkistan provided the source of resistance found in Ranger. Today most of the experimental lines developed at Western Stations carry factors for resistance to bacterial wilt.

The successful return of alfalfa to the Eastern States is credited to more information on its fertility requirements. It has been cultivated for several decades in some parts of the Atlantic Seaboard states, but there has been little or no opportunity for the evolution of better adapted strains such as occurred in the case of the Common alfalfas. The grower turns under the surviving plants in his old fields and returns to western seed to establish new stands. To him seed production is a financial risk.

The breeder in the Eastern States is faced with the problem of breeding for resistance to several diseases, each a potential cause of crop failure. At the same time, he must maintain resistance to bacterial wilt and other characters which constitute productiveness in the West, The complexity of the problem presents a challenge to the plant breeder. It is encouraging to note, however, that some of the better lines in the East are also quite productive in the West.

In regard to the breeding work at this station, the collection and evaluation of available plant materials have received the major portion of our attention during the past years. Data on stand survival and resistance to diseases has been obtained on all occasions and in most cases hay yields have also been determined.

Atlantic alfalfa has been outstanding in all tests, yielding 12-24% more than Kansas Common. However, it is quite susceptible to bacterial wilt, which may account for the difficulties involved in seed increasing. A French introduction, tested for the first time last year, was comparable to Atlantic in

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yield, but more resistant to Sclerotinia stem rot and some leaf and stem diseases. Under Kansas conditions, however, it was observed to be very susceptible to leaf hoppers. Sclerotinia caused considerable damage to seedling alfalfa last winter in North Carolina, but severe damage was limited largely to fields where alfalfa followed one of the clovers. The performance of some Nebraska entries are outstanding during the spring, but decline in productivity as the season advances. In our tests, Williamsburg has yielded more than Kansas Common but somewhat less than Atlantic. In general, northern varieties such as Baltic, Grimm and Ladak, are less productive than Kansas Common and shorter-lived. Likewise, Arizona Chilean and Argentine Alfalfa have also been somewhat inferior. A summer killing has been observed to be a factor in stand reductions, some strains being much more susceptible than others.

Differences among lines have also been noted in respect to resistance to aphids, leaf blotch, the common leaf spot, and rust. Selections have been made for some of these characters. Our older plots are now much reduced in stand and the more productive lines offer a promising source of breeding material.

Obviously, the plant pathologist plays a key role in the breeding of Eastern alfalfas. All of the pathological causes of unproductiveness are by no means clearly understood; techniques need to be developed for production of disease epidemics under nursery condition.

After the selection of promising individuals, follow the determination of combining ability and progeny performance, and the production and testing of synthetic combinations--steps which require a well coordinated program with workers in the seed growing area. In this respect, we are deeply indebted to the Kansas and Nebraska Stations for their cooperation and support. The National Alfalfa Improvement Conference has greatly facilitated the exchange of information and materials.

It is quite apparent that too much emphasis cannot be given to the importance of an integrated program - one in which the efforts of the plant breeders and pathologists of the East and the West are well coordinated.

Studies On Alfalfa Diseases In Virginia

R. G. Henderson*

The widespread planting of alfalfa has brought forth many disease problems. These diseases vary in intensity from farm to farm and season to season. In the spring, Sclerotinia stem rot, Pseudopeziza leaf spot, black stem, and downy mildew predominate, while in midsummer and early fall Southern anthracnose, Stemphyllium and Cercospora leaf spots, and wilts overshadow other troubles. In the fall a combination of several diseases is apparently responsible for the loss of stand in new seedings and old stands alike. More intensive studies on stand losses are needed.

Black stem, caused by Ascochyta imperfecta, is a cool weather disease that becomes established on the old stubble in the fall and ravages the new growth the following spring. It has been very destructive the past two seasons.

* Pathologist, Virginia Agricultural Experiment Station, Blacksburg, Va.

Observations on the reaction of varieties to black stem strongly suggest that improved varieties can be obtained. In tests conducted during the past two seasons with 12 varieties, Atlantic showed the least injury and Utah Common the greatest injury. Several strains of Argentina alfalfa observed in one test in 1948 appeared to be very susceptible.

Pseudopeziza leaf spot occurs generally and in many instances causes severe defoliation. Observations indicate that the varieties generally available are moderately susceptible under favorable conditions. Certain strains from Argentina and one strain of Ladak appeared to be the least susceptible of those tested. Individual plants were observed in several varieties which showed very slight leafspot injury.

Stemphylium leafspot in general has not appeared to be as destructive as Pseudopeziza leafspot, but may cause considerable burning in late summer. The majority of the varieties now available appear moderately resistant, with the exception of Hardistan and Ladak. The Ranger variety is rather susceptible.

The Sclerotinia stem rot disease is variable in its occurrence and in its destructiveness. It is more widespread in the eastern and southern portions of Virginia, but has also been observed in other areas. On alfalfa, injury is largely limited to the first season and more specifically to the crop seeded in late fall. In a one-year test, alfalfa seeded from May to August, inclusive, showed less than 2% kill the following spring while that seeded in September showed more than 25% kill.

Studies on southern anthracnose have not been extensive enought to fully evaluate the importance of this disease. Colletotrichum trifolii is frequently found on diseased alfalfa stems and it has been isolated from the crowns of dying plants. In a few instances anthracnose has been suspected of being the chief cause of stand loss, but more often it occurs in combination with other diseases which complicate the diagnosis.

Bacterial wilt (phytomonas insidiosa) has been identified in several old fields but at present it does not appear to be a major threat to alfalfa production. The wilt resistant variety, Buffalo, has produced well under Virginia conditions and should be used on fields suspected of carrying the organism.

The stem namatode disease (Ditylenchus dipsaci) has only been observed on one farm in Virginia but it has caused such serious losses on this farm that the farmer has discontinued the seeding of alfalfa. Alfalfa seeded on infested soil last August was practically all gone by June this year. Seed of several alfalfa strains selected for nematode resistance by Dr. O. M. Smith, Plant Pathologist, U.S.D.A., were seeded on this farm last summer along with four standard susceptible varieties. By late fall differences in the vigor of the plants on several plots could be detected. In early spring, the differences in stand and vigor was remarkable. The susceptible varieties (Kansas, Buffalo, Atlantic and Williamsburg) were poor while several of the numbered strains showed good stands and considerable vigor. The variety Nemastan was poor. The two strains, No. 77-48 and No. 77-97, were superior to the others without question.

Other diseases, such as black stem and leaf spot were present and probably caused considerable injury to some of the nematode resistant strains. The good appearance of at least two of the nematode resistant strains suggest that stem nematode resistant varieties adapted to Virginia conditions can be obtained.

Alfalfa In Alabama (Abstract)

D. G. Sturkie*

Because of its quality and value both as hay and forage, alfalfa has long been considered the ideal forage crop.

Because of the limited fertility of most Alabama soils, alfalfa was not grown successfully except to a small extent in the Black Belt and Tennessee Valley areas. As a result of experiments in recent years, alfalfa gives promise of becoming an important hay and grazing crop in the state.

It is known that alfalfa requires a soil of high fertility and lime content for successful production. Results of investigations begun in 1931 show that the fertility requirements of alfalf probably can be met and that it can be established and maintained on practically all of the better well-drained soils of the state.

A review of the research work with alfalfa in Alabama was made at the meeting of the Southern Agricultural Workers in February, 1948. It is not necessary to review this work at this meeting. At present the fertilizer recommendations for alfalfa are as follows:

For the greater portion of the state, apply 2 tons per acre of lime, 500 to 600 pounds of superphosphate, 200 to 300 pounds of muriate of potash, and 20 pounds of borax prior to seeding the alfalfa. Annual applications of 500 to 600 pounds of superphosphate, 200 to 300 pounds of muriate of potash and 15 pounds of borax should be made in the spring before growth begins.

On sandy soils of central and southern Alabama, the potash should be increased to 400 pounds of muriate per acre. In extreme conditions, particularly in southern Alabama, 600 pounds of muriate of potash may be necessary. On extremely acid soils, lime applications should be 4 or perhaps 8 tons, instead of the general recommendation of 2 tons.

As to time of planting, results in Alabama have always shown that fall planting is a MUST.

The average yields of alfalfa in tests have varied from 3 to 5 tons of hay per acre per year.

At present, alfalfa is being used as a basis for the grazing for hogs, in which it supplies nearly or all of the protein and vitamins. Another use if for grazing for dairy cattle.

Some of the probelms with alfalfa are:

1. Management: When should it be cut for maximum yield and quality? When can it be grazed without injury, or with a minimum of injury?

* Agronomist, Alabama Agricultural Experiment Station, Auburn, Ala.

2. Insects: What are the pests and their control? In Alabama, damage has been severe from blister beetles and army worms.

3. Diseases: Leaf spot, stem rot, anthracnose and nematodes.

4. Mineral nutrition: How to maintain Ca and K, etc., on soils subject to leaching under heavy rainfall. What is the need for other minor elements?

5. Seed production: How to produce a seed crop under humid conditions. What is the role of insects in increasing yield or decreasing yield?

6. Breeding: Improvement of alfalfa for humid conditions is essential. Factors needing improvement are resistance to disease and insects, higher yield and ability to grow in hot weather.

The Future of Alfalfa.

Are southern farmers ready for a crop like alfalfa? Do they have the skill necessary to produce and use efficiently a highly nutritious crop like alfalfa? Are the livestock sufficiently high in productive capacity to utilize a feed like alfalfa? A cow giving 2 gallons of milk a day might do just as well on a cheaper roughage as on alfalfa, while a cow capable of giving 6 gallons a day might require a high grade feed like alfalfa for maximim production. The future of alfalfa in the South will be determined by the ability of the farmers to master the production and utilization of the crop. The pattern of the essentials for production is already set, refinements will be made by research in the future. Whether future research will be profitable, will be determined by the answer the farmer gives to the question, "Can he use the crop efficiently?".

Alfalfa Production In Georgia

L. C. Olson*, O. L. Brooks**,
and Edwin James***

Alfalfa has gained considerably in popularity in Georgia during the past decade. Part of the increase in acreage may be ascribed to the expanded livestock program and the need for good quality hay and partly due to a better knowledge of proper growing conditions. At the present time, most of the alfalfa is grown in the Piedmont, Mountain, and Limestone Valley sections of the state, with some being grown in the Coastal Plain section. Experiments have been conducted with this crop for many years and an expanded program was begun in 1941. Some of the factors which have limited alfalfa production in the past have been solved, yet much more remains to be done.

This report includes studies conducted by the Georgia Experiment Station at Experiment, the College of Agriculture at Athens, and the Georgia Mountain Experiment Station at Blairsville. The various projects involve rates and dates of seeding, rates and kinds of fertilizer and lime, various seed bed preparations, varieties, and placement. Soil types on which tests were conducted were Lloyd, Cecil, and Davidson in the Piedmont; Colbert, Dewey, Fullerton, Pace, and Clarksville in the Mountain Section; and Orangeburg in the Coastal Plain section.

Rates of seeding varied from 10 to 50 pounds per acre. The number of plants per square feet was 11.6 for the 10-pound rate and 17.3 for the 50-pound rate. The yield varied from 7 tons of hay per acre, green weight, for the lowest rate to 8.5 tons per acre for the highest rate of seeding. Where seedings are made by hand on small plots, it is possible that the rreults will not be comparable to those done on a larger scale with the power equipment.

Dates of seeding were conducted for two years at Macon and Experiment. February seedings germinated well but a 12 to 14 degree cold spell caused a complete failure. Seedings made in March at Experiment were poor due to competition with weeds. Spring seedings, however, are sometimes successful. Seedings made in the fall in August, September, October, and November have been quite satisfactory but the August seedings have been much more weedy than later seedings.

Seedbed preparation and methods of seeding. Good results have been obtained both with a cyclone seeder and grain drill where a thorough seedbed preparation has been made. The use of a cultipacker before and after seeding appears to be necessary where the seed is broadcast but where a drill is used, the cultipacker after seeding does not seem to be necessary.

Rates of Borax and Minor Elements. At three locations in the Piedmont and five in the Mountain section borax appeared to have a slight depressing effect on yield. Rates of boraz varied from none in the Piedmont to 40 pounds, while in the Mountain section the rates used ranged from 15 to 40 pounds borax per acre.

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*** College of Agriculture, University of Georgia, Athens, Ga.

Applications were made both prior to seeding and after the first cutting. At Panthersville, in DeKalb County, 20 pounds of borax applied before seeding resulted in a 20% reduction in stand but only a 3% reduction in yield. On Orangeburg sandy loam, in the upper Coastal Plain, boron-deficiency symptoms occurred and an application of 20 pounds of borax brought about a 25% increase in yield.

Other minor elements or secondary elements used in the tests included copper, manganese, zinc, magnesium, and sulfur. Plots receiving copper had a better color than other plots but no difference in yield was obtained. Where 46% superphosphate was used, an application of gypsum increased the yield about 12%. The other elements studied had no appreciable effects on yield or appearance.

Rates and kinds of phosphate. Rates of phosphate varying from 50 to 250 pounds P_2O_5 per acre had no appreciable effect on yield. In the Mountain section there was a definite trend for the higher rates of phosphate to decrease yield.

In new phosphate investigations at Experiment, radio-active phosphate from two sources; namely, 20% super and alpha-tri-calcium have been applied at 3-inch and 8-inch depths on established alfalfa on Cecil clay loam. Although the soil was unusually dry and hard, no difficulty was experiemced in the use of the subsoil placement equipment which was pulled by a Ford tractor. Radio-active fertilizer was applied at the rate of one plot every two minutes. It is believed that these deeper placement tests will be of benefit in determining why alfalfa stands do not persist longer than three to five years, although adequate supplies of potash, borax, and other plant nutrients have been applied to the surface.

Rates of potash. In testing samples from farms throughout the state where alfalfa failures have been reported, it has been found in general that the lime and phosphate in the soil has been high while the exchangeable potash has been low. When the exchangeable potassium in the surface soil falls below 50 parts per million, the stand of alfalfa is practically impossible to maintain. Tests in the Piedmont and Mountain sections of Georgia with rates of potash varying from 50 to 300 pounds K_2O per acre indicate that 100 pounds of K_2O applied annually is generally adequate. It is believed that with the soils in the Coastal Plain, a greater amount will be needed. Tests on these soils with amounts up to 400 pounds of K_2O per acre per year are under way.

Rates and kinds of lime. For most crops grown in Georgia, dolomitic limestone has been found superior to other kinds. Results with alfalfa indicate that other kinds of liming material may be better. On a Davidson soil which had already been limed to a pH of above 6.2, an application of burnt lime doubled the yield. A three-ton application of dolomitic limestone increased the yield by about 33%, while the same amount of calcic limestone increased the yield by 50%.

Summary and discussion. Although information obtained from various experimental plots such as those reported have been helpful in producing higher yields and maintaining stands for a longer period, there is still much work to be done with alfalfa. It is believed that one of the reasons for the failure of alfalfa in the Piedmont is the deficiency of plant food, particularly phosphate, in the subsoil. The work being done at Experiment with deep placements of different kinds of phosphate, both radioactive and normal, should furnish valuable information along this line.

Cultivation, especially with alfalfa grown on heavy clay soils, may be of value. Rotations with alfalfa have received little, if any, attention. Varieties of alfalfa used have been fairly satisfactory but a breeding program is very much needed.

Alfalfa Production in North Carolina (Abstract)

W. W. Woodhouse, Jr.*

Slides were used to show that (1) lime should be mixed with the soil for alfalfa, (2) alfalfa is particularly responsive to phosphate levels in the early stages of establishment, (3) under North Carolina conditions the residual effect of P fertilizers is effective on alfalfa for several years after application, and (4) alfalfa draws heavily on excess potash applications. North Carolina fertilizer recommendations for alfalfa were summarized. At planting, 700 to 1,000 pounds 2-12-12 or 500 to 1,000 of 20% superphosphate plus 500 pounds 2-12-12. Maintenance, 400 to 500 pounds 0-9-27, 0-10-20 or 0-12-12 annually.

* Agronomist, North Carolina Agricultural Experiment Station

Diseases of Forage Grasses and Legumes

J. Lewis Allison*

Grasses and legumes, like all other economic plants, are hosts to many diseases. To illustrate: In the United States, more than 45 diseases are known to attack Kentucky bluegrass, 35 timothy, 30 orchard grass, 50 alfalfa, 30 red clover, and 25 sweet clover.

The bacteria, fungi, viruses, nematodes, and a few parasitic seed plants are among the pathogens that cause the diseases. The fungi are most to blame, but the others also are responsible for several economically important diseases. Non-parasitic disorders that frequently are mistaken for parasitic diseases are common to some grasses and legumes; actually they are caused by hereditary or physiological factors.

The diseases can be classified into three major groups according to the parts of the plant they attack: root disorders, foliage disorders, and flower and seed disorders.

Root disorders are caused by the soil-inhabiting bacteria, fungi, and nematodes. Foliage disorders are caused by bacteria, fungi, and viruses. Fungi, nematodes, and parasitic plants cause flower and seed disorders.

Of these, root disorders are the least conspicuous, but they include several of the economically important pathogens and generally are responsible for the inability to establish initial seedings of grasses and legumes or the rapid depletion of already-established stands.

* Senior Pathologist, U.S.D.A., and Research Professor, North Carolina State College, Raleigh, N. C.

Foliage disorders, the most conspicuous group, include only a relatively small number of pathogens that are economically important. They destroy only the foliage, the part of the plant that is readily regenerated, especially in perennials.

Flower and seed disorders have economic importance only when crops are grown for seed. Some of this group are highly destructive and seriously hamper seed production. One -- ergot, a fungus disease -- can poison livestock if infected grasses are heavily grazed.

The diseases generally are limited to certain regions. The pathogens are usually specific, attacking only a single species or species in a single genus. Accordingly, the diseases of economic importance in a given region are those that attack the dominant grasses and legumes in the region, although a few pathogens are destructive to several widely-divergent species.

Environmental conditions, especially temperature and moisture, limit the range and destructiveness of diseases. These two factors limit certain diseases to geographic regions; they may be the reason why a disease becomes economically destructive one season and diminishes to one of minor consequence the following season.

Sanitary measures, important in checking many diseases, are impractical in checking grass and legume diseases under field conditions. For one thing, waste areas into which grasses and legumes spread by natural means are inaccessible for control practices. Crop rotation, important in combating many soil-borne diseases, is not readily applied to grasses and legumes. Many are perennial, and are used in permanent pastures where diseases can run an uninterrupted course. Chemical control of foliage diseases with sprays and dusts is impractical because of the possible poisoning hazard to livestock. Seed treatment for seed-borne diseases is not commonly practiced. Many grass seeds are difficult to treat because they are so small or have awns and other parts that interfere with treatment, and bacterial inoculants necessary in establishing good stands of legumes are not compatible with the seed protectant chemicals.

The development by means of selection and hybridization of strains and varieties of grasses and legumes resistant to the diseases that attack them is the only practical control for most diseases. Disease resistance has been demonstrated for many species and breeding and improvement programs are under way in an effort to incorporate these factors into the germ plasm of improved varieties.

12:30 P.M. Lunch.

Business Meeting

A short business meeting was held at the conclusion of the alfalfa symposium.

The chairman indicated that the meeting was open for suggestions as to a place of meeting for next year. Dr. R. C. Potts extended an invitation to the group to come to College Station, Texas, in 1950. A motion to accept the invitation was made and unanimously approved. The time of the meeting was left up to Dr. Potts and his associates.

In the closing minutes of this last session, a unanimous vote of appreciation was extended to the North Carolina staff by those in attendance for having contributed so much to making this Sixth Pasture Conference a real success.

Executive Committee - 1949

H. W. Bennett	State College, Miss.	1949	
T. J. Smith	Blacksburg, Va.	1950	Chairman
O. E. Sell	Experiment, Ga.	1951	
C. R. Owen	Baton Rouge, La.	1952	
Paul R. Henson	Beltsville, Md.		Secretary
R. H. Lush	Dairy Husbandry	Knoxville, Tenn.	
E. H. Hostetler	Animal Husbandry	Raleigh, N. C.	

Field Trip - Thursday afternoon, June 16, 1949.

The first stop was at the W. V. Green farm on a Cecil sandy loam approximately nine miles north of Raleigh. The North Carolina Agricultural Experiment Station has leased approximately three acres of land for forage crop experiments at this location. Some of the experiments are discussed below.

Above and Below Ground Relationships of Alfalfa and Orchard Grass.

In this investigation, on a Cecil sandy clay loam, a study is being made of the associational effects between alfalfa-orchard grass mixtures. A study of the above ground associational effects was facilitated by partitioning the root systems with sheet metal barriers, spaced vertically 6 inches apart. The above ground parts were allowed to intermingle; whereas the below ground parts were separated. Bouyoucos' moisture blocks were installed prior to seeding of the experiment September 1, 1947. These were placed at depths of 3, 6, 12, 24 and 30 inches, directly under variously arranged rows of alfalfa and orchard grass in the five replications. Soil moisture readings were made on 55 days in 1948, from April 21 to September 20. Readings are being made three times weekly in 1949.

Excavations of border rows, one year following seeding, showed that alfalfa and orchard grass roots had permeated the soil to a maximum depth of 36 inches.

A dryness of 75,000 ohms resistance has been arbitrarily used by several investigators as an indicator of the wilting percentage. On 22 percent of the reading dates in 1948 the soil was dryer than 75,000 ohms at the 3, 6, 12, 24 and 30-inch levels under alfalfa.

There was evidence of above and below ground competition between alfalfa plants for the various growth factors. Orchard grass was benefited by its above ground association with alfalfa.

Rates and Methods of Seeding Alfalfa-Orchard and Alfalfa-Tall Fescue.

In this study, rates of seeding ranging from 10 to 20 pounds of alfalfa and 5 to 15 pounds of grass are being evaluated. Comparisons are being made between alternate row, mixed in the row and broadcast methods of seeding. The spacing between rows is 6 inches. The plots were seeded August 31, 1946, and total yield determinations and botanical analyses were made during 1947 and 1948. All treatments are botanically separated by hand twice annually. The experiment will be continued several more years.

Alfalfa Strain Test

The 36 entries in this strain test have shown differences in respect to forage yields, and resistance to Sclerotinia stem rot and the leaf spots. DuPuits is the most resistant of those tested, while the greatest susceptibility is found in the Nevada entries.

Stop Number 2 was at the J. J. Sanders farm about 25 miles from Raleigh, where approximately three acres of land have been leased for forage crops research. Rain prevented the group from entering the experimental field, but

certain aspects of the experiments at this location were discussed.

Alfalfa Strain Tests

The strain test, seeded in 1948, consisted of 23 lines which had not been grown previously in North Carolina, and 7 commercial checks. Atlantic and DuPuits were the most productive strains in this test. Some of the newer synthetics have yielded more than Kansas Common but somewhat less than Atlantic.

The results of the PKLB experiment at this location had been previously discussed.

Additional work at this location includes the effect of boron on seed yield of alfalfa, radioactive phosphorus studies on alfalfa, and alfalfa root studies.

June 17, 1949.

The conference officially ended on June 16. As had been suggested at the end of the 1948 meetings, several tours were outlined in such a manner that members of the conference could see additional experimental work and type farming within the state on their way home.

A part of the group travelled westward from Raleigh to the Great Smokey Mountains. At the Waynesville Experiment Station they saw a very comprehensive watershed study being initiated. This cooperative T.V.A. project, conducted by Dr. W. W. Woodhouse, Jr., and Mr. M. J. Gilbert, will use Coleman fiber glass moisture elements and a weir arrangement to correlate land use with water utilization. Other experiments on fertility and observational nurseries were observed also.

Another group travelled eastward to the Tidewater Experiment Station where they saw experimental plots of grass-legume mixtures, fertility experiments on big trefoil (Lotus uliginosus) and Ladino. Big trefoil had looked so well in preliminary work at Plymouth that it has been placed in a beef grazing trial. This grazing trial was initiated in the fall of 1948 and involves twelve two-acre paddocks comparing big trefoil and Ladino, each having been planted with orchard grass. From Plymouth this group travelled to the Coastal Plain Experiment Station at Willard. Here they saw breeding nurseries and miscellaneous experimental work.

A third group made further investigations of the agriculture in the vicinity of Raleigh. This tour depicted the successful change which North Carolina farmers have made by converting from row crops to grassland farming.

REGISTRATION LIST
Southern Pasture and Forage Crop
Improvement Conference
1949

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Evans, E. M.	Alabama Experiment Station	Auburn
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Henderson, J. R.	Agric. Extension Service	Gainesville
Hodges, Elver M.	Range Cattle Station	Ona
Killinger, G. B.	Florida Expt. Station	Gainesville
McCloud, D. E.	Agric. College, Univ., of Fla.	"
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James, Edwin	University of Georgia	Athens
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Sell, O. E.	" " "	"
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MISSOURI		
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Bell, Loyd V., Jr.	N. C. Expt. Station	Raleigh
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Dillard, E. U.	" " "	"
Dobson, S. H.	Agric. Extension Service	"
Faires, E. W.	Coastal Plain Station & USDA	Willard
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Hostetler, E. H.	" " "	"
Hughes, Ralph	N. C. Expt. Sta. & S.E. Forest Experiment Station	Plymouth
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Lucas, H. L.	" " " "	"
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Waugh, R. K.	" " "	"
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Tabor, Paul	Soil Conservation Service	Spartanburg

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Johnson, Henry	Rice-Pasture Expt. Station	Beaumont
Johnson, P. R.	Texas Agric. Expt. Station	Tyler
Potts, R. C.	" " " "	College Station
Weihing, Ralph M.	Rice-Pasture Expt. Station	Beaumont

VIRGINIA

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Jones, Geo. D.	" " " "	Orange
Kipps, M. S.	Agronomy Dept., V.P.I.	Blacksburg
Lewis, W. W.	Va. Agric. Extension Service	"
Mathews, G. R.	" " " "	"
McCulley, R. D.	Agric. Expt. Station	Franklin
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Sears, R. D.	Va. Agric. Extension Service	"
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Davis, J. B.	" " " "	"
Keatts, Miss Cecile E.	" " " "	"